3.7 WEAPONS GUIDED

EADSIM has the capability to model most types of weapon systems including both guided and unguided weapons with either implicit or explicit flyouts (with certain restrictions) as listed in Table 3.7-1. Implicit flyouts are modeled with constant speed flying in a straight line to the intercept point or can have non-linear flyouts defined through missile flyout tables. When a weapon reaches its target, a kill/no-kill determination is made based on the weapon Pk defined for that target by the user. Semi-active missiles require a sensor track by the launch platform on the target all the way through intercept. "Fire-and-forget" missiles and guns only require track through launch of the weapon. The Non-Line-of-Sight (NLOS) weapon requires track on the target at the time of engagement decision; however, this track does not have to be from a sensor on the platform.

TABLE 3.7-1. Available EADSIM Weapons Types and Corresponding Guidance Modes.

Weapon Type	Available Guidance Modes
Thrusted	Semi-active Active Non-Line-of-Sight Infra-Red Programmed Anti-Radiation
Ballistic	NA
Bomb	Free Fall
Cruise Missile	Programmed
Anti-Weapon	Free Fall
Gun	None
Warhead	None

Higher fidelity weapon system modeling is available for air-to-surface missiles and for surface-to-surface missiles. Air-to-surface missiles can be modeled as "captive platforms." Once launched, captive platforms are capable of performing any of the functions that a platform with the same ruleset can perform. For example, an air-launched cruise missile defined as a captive platform can follow a defined set of waypoints, fly into its target, and cause the kill/no-kill determination to be performed.

The surface-to-surface modeling handles both tactical ballistic missiles and cruise missiles. Both of these missiles types are flown by the FP process. The user has the ability to fly ballistic missiles through a variety of guidance options. They can be scripted or are launched in response to a decision to fire in a counter-force role. Cruise missiles are modeled with constant velocity, constant altitude above ground level (AGL) flight. When better cruise missile modeling is required, captive platforms provide an alternative; however, they are limited to scripted launch. The kill assessment for the surface-to-surface weapons is the same as for other missiles, i.e., all engagements are all-or-nothing events, except that partial damage may be assessed against an airbase. For further information on weapon system modeling see the EADSIM Methodology Manual [2] or User's Reference Manual [3].

3.7.1 Objectives And Procedures

The objective of this analysis was to examine the effects of altering certain weapon system characteristics for selected weapon types in the Demo300 scenario. Two different weapon types were selected, the Russian AS-11, Kilter missile, which is an air-to-surface anti-radiation missile, and the AIM-120, Advanced Medium-Range Air-to-Air Missile (AMRAAM). Weapon parameters varied were Pk, range, and velocity. The values for each parameter series are listed in Table 3.7-2, and 10 Monte Carlo replications were run for each series. Each of weapon system parameters varied are defined in the weapons definition window. An illustration of the AMRAAM definition window is presented in Figure 3.7-1.

TABLE 3.7-2. KILTER missile parameter variations.

SERIES	PARAMETER VARIATION	VELOCITY (m/s)	RANGE (m)	PK(%)
1	Default	1400	22000	50
2	Pk	1400	22000	25
3	Pk	1400	22000	75
4	Range	1400	10000	50
5	Range	1400	30000	50
6	Velocity	600	22000	50
7	Velocity	1200	22000	50
8	Velocity	1600	22000	50

TABLE 3.7-3. AMRAAM Missile Parameter Variations.

SERIES	PARAMETER VARIATION	VELOCITY (m/s)	RANGE (m)	PK(%)
9	Default	1400	600000	55
10	Pk	1400	600000	25
11	Pk	1400	600000	75
12	Range	1400	60000	75
13	Range	1400	60000	55
14	Range	1400	30000	55
15	Velocity	1600	600000	55
16	Velocity	1200	600000	55

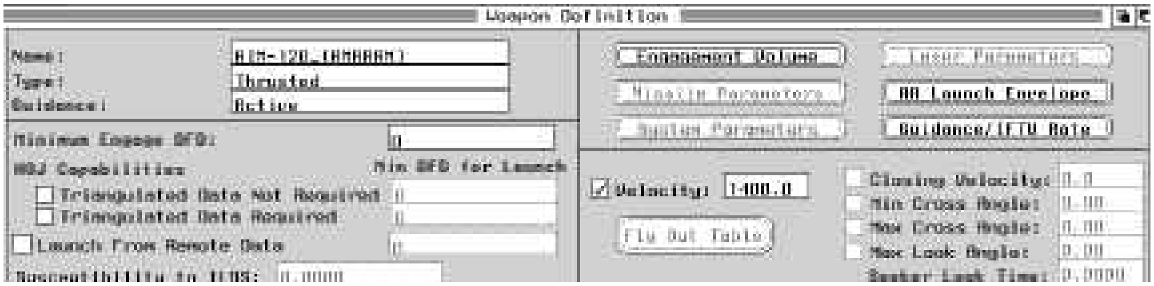

FIGURE 3.7-1. AIM-120 (AMRAAM) Weapon Definition Window.

3.7.2 Results

The attrition results averaged over each red aircraft type for the 16 analysis conditions are summarized in Table 3.7-4 for the Kilter and in Table 3.7-5 for the AMRAAM. Relatively little sensitivity to changes in Kilter characteristics are apparent in the attrition results while somewhat larger sensitivities are observed for changes in AMRAAM characteristics. This difference is relatively easy to rationalize based on the role of these two weapons in the Demo300 scenario. There is one Red wild weasel (REDWW) in the scenario loaded with four AS-11 Kilter missiles. Its mission is to target both of the Hawk radars and eliminate that SAM threat. In the baseline (default) Demo300 scenario, the Hawk missiles account for only 3% of the overall red aircraft attrition; therefore, attrition should be relatively insensitive to changes in Kilter performance. On the other hand, each of the 24 blue F-15 aircraft carry 6 AMRAAM missiles each, and they account for over 97% of the red aircraft attrition; therefore, the attrition MOE should be more sensitive to changes in AMRAAM characteristics.

TABLE 3.7-4. RED attrition for variations in AS-11 Kilter characteristics.

PLATFORM	Series 1	Series 2	Series 3	Series 4	Series 5	Series 6	Series 7	Series 8
Red_CM	5.0	5.0	5.0	4.9	5.0	5.0	5.0	5.0
Fulcrum	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

TABLE 3.7-4. RED attrition for variations in AS-11 Kilter characteristics.

PLATFORM	Series 1	Series 2	Series 3	Series 4	Series 5	Series 6	Series 7	Series 8
Flogger	15.0	15.4	15.3	15.0	15.3	14.0	14.7	14.5
Fencer	8.0	8.0	8.0	8.0	7.9	8.0	7.9	8.0
Flanker	3.0	2.9	3.0	3.0	3.0	3.0	3.0	3.0
Backfire	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red_WW	0.8	0.3	0.9	1.0	0.3	0.5	0.7	0.4
Red_BAI	0.8	0.9	0.7	0.5	0.9	0.9	0.8	0.7

TABLE 3.7-5. RED attrition for variations in AIM-120 AMRAAM characteristics.

PLATFORM	Series 9	Series 10	Series 11	Series 12	Series 13	Series 14	Series 15	Series 16
Red_CM	5.0	4.5	5.0	5.0	5.0	5.0	5.0	5.0
Fulcrum	6.0	5.7	6.0	6.0	6.0	6.0	6.0	6.0
Flogger	15.0	12.5	15.8	15.7	15.0	14.9	15.4	14.8
Fencer	8.0	8.0	8.0	8.0	7.9	8.0	8.0	8.0
Flanker	3.0	2.1	3.0	3.0	2.9	2.7	2.9	2.9
Backfire	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red_WW	0.8	0.7	0.4	0.6	0.5	0.4	0.6	0.8
Red_BAI	0.8	0.9	1.0	0.7	0.7	0.6	0.8	0.6

In order to illustrate the differences in attrition between the Kilter and AMRAAM as a function of Pk, the cumulative attrition as a function of scenario time is plotted for each in Figures 3.7-2 and 3.7-3. In Figure 3.7-2, there are some small differences in attrition between series with different Kilter Pks; however, these are assessed not to be statistically significant. There are larger and more significant differences in attrition for different values of AMRAAM Pk as a function of scenario time (Figure 3.7-3), but after 16 minutes, the series with Pk=0.75 and the series with Pk=0.55 have both achieved nearly 100% attrition of red aircraft. So while the final difference in attrition between these two cases isn't significant, the differences at intermediate times are.

Overall attrition for red aircraft as a function of the three AMRAAM characteristics varied are plotted in Figures 3.7-4, 3.7-5, and 3.7-6. Of these only the AMRAAM Pk had any significant impact.

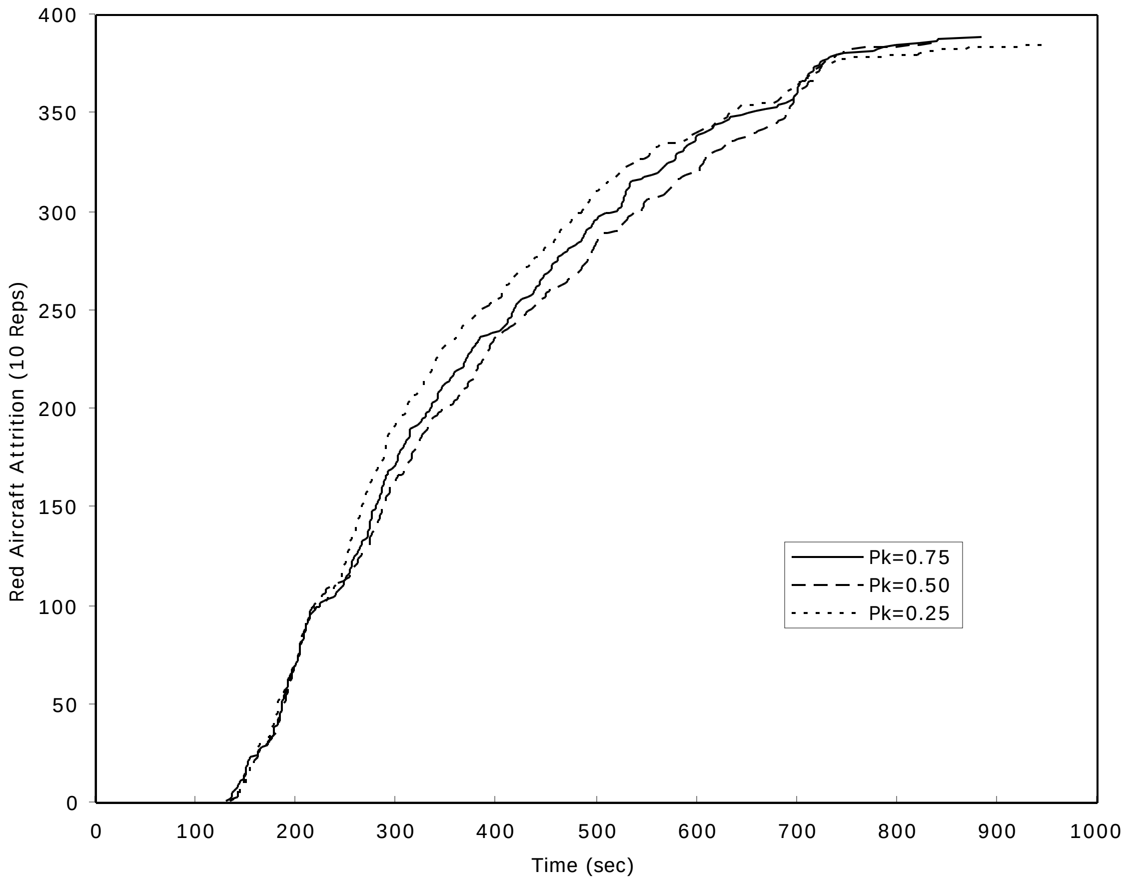

FIGURE 3.7-2. Red Attrition as a Function of Scenario Time for Different Values of the AS-11 Kilter Pk.

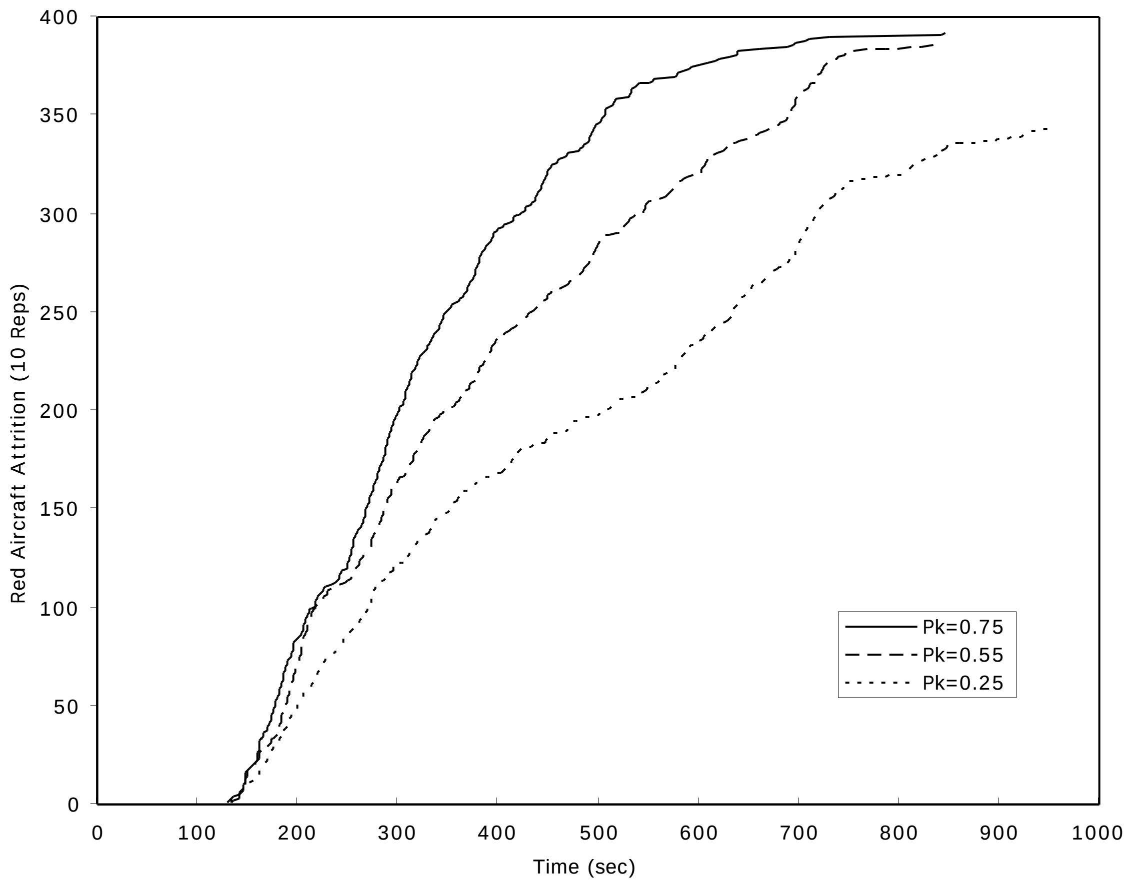

FIGURE 3.7-3. Red Attrition as a Function of Scenario Time for Different Values of the AIM-120 AMRAAM Pk.

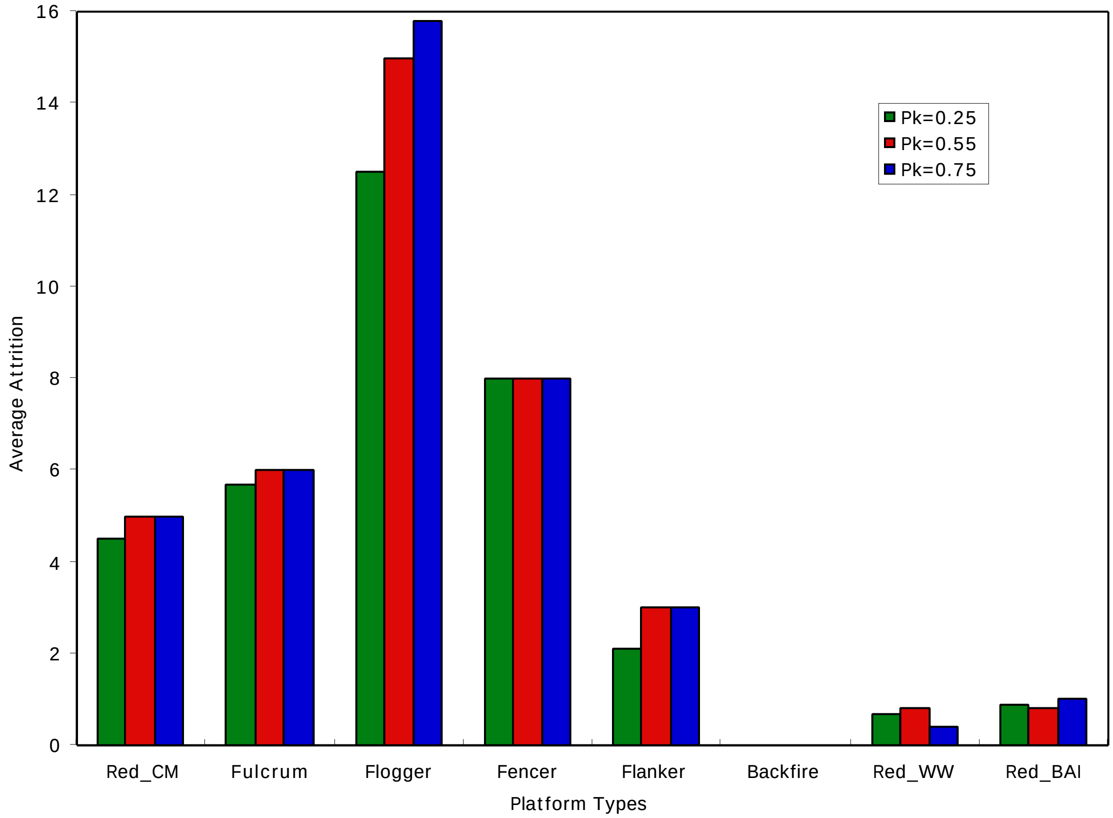

FIGURE 3.7-4. Average Red Attrition as a Function of AMRAAM Pk.

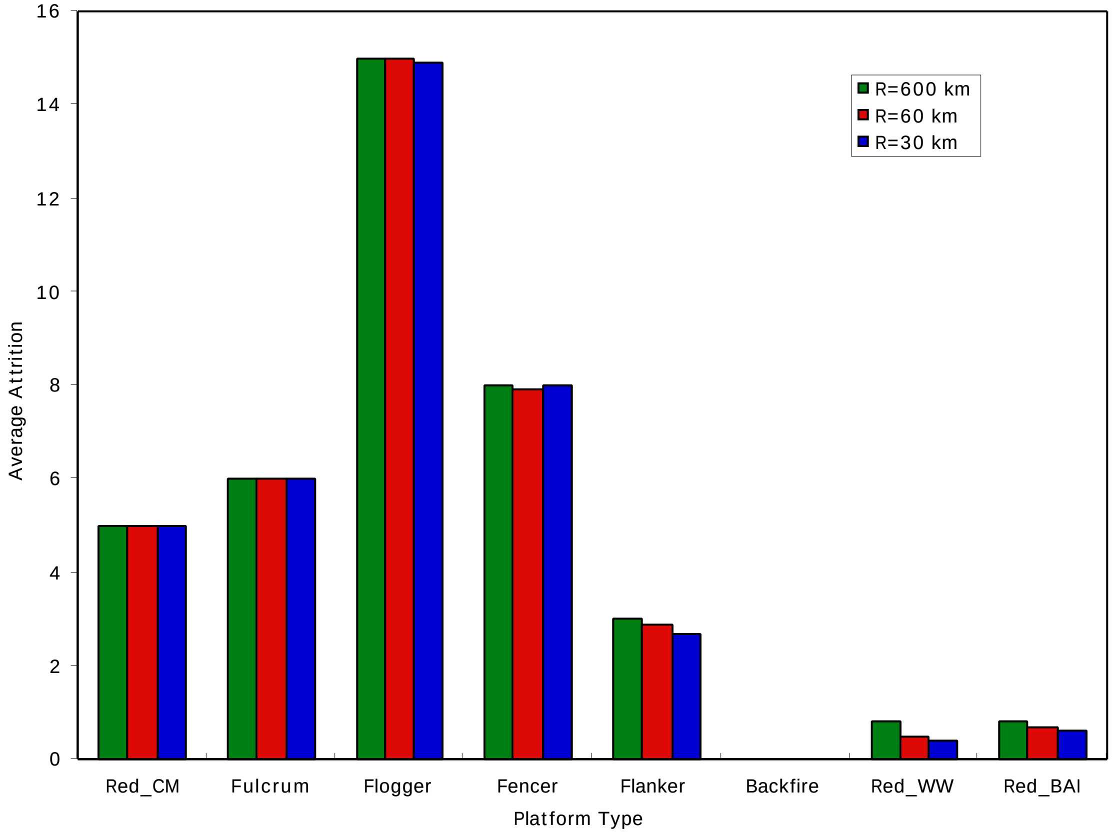

FIGURE 3.7-5. Average Red Attrition as a Function of AMRAAM Range.

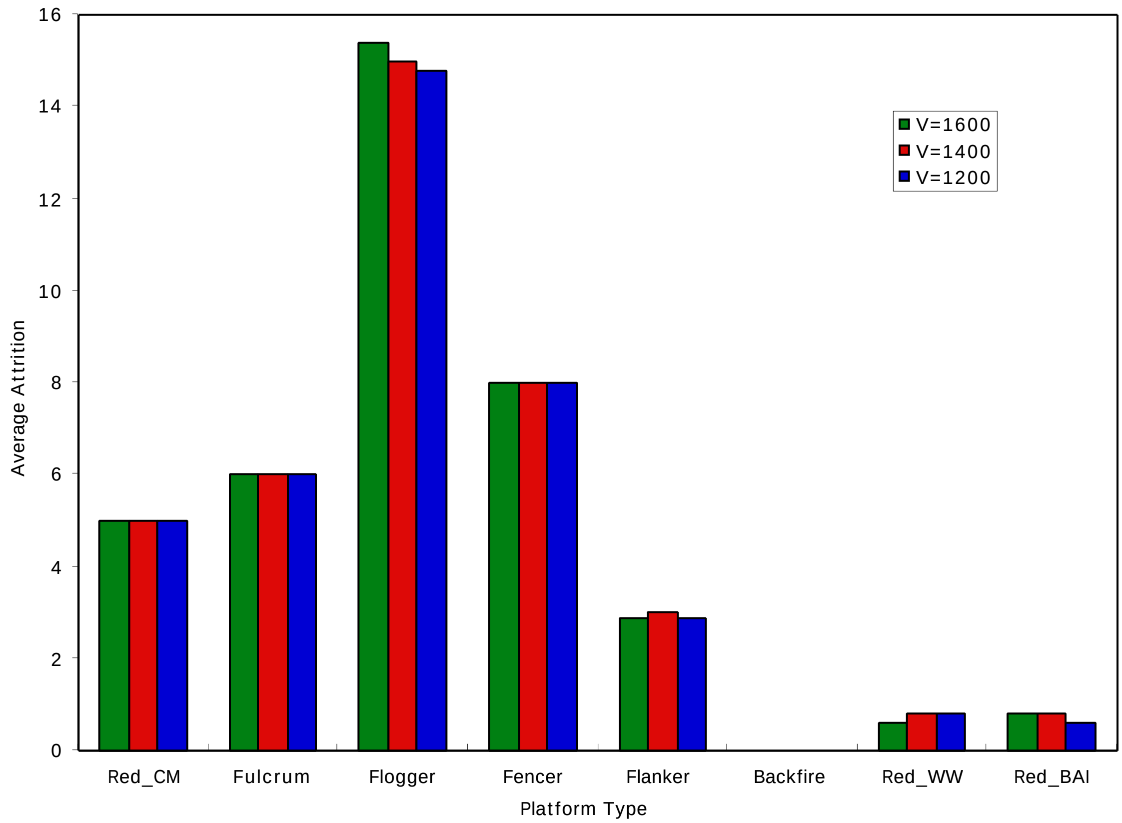

FIGURE 3.7-6. Average Red Attrition as a Function of AMRAAM Velocity.

3.7.3 Conclusions

Of the three weapon element parameters varied in the sensitivity analyses described here, only weapon Pk was found to have any significant impact on red aircraft attrition, and that was only for the AMRAAM weapon type which was the predominant source of red attrition in the Demo300 scenario.